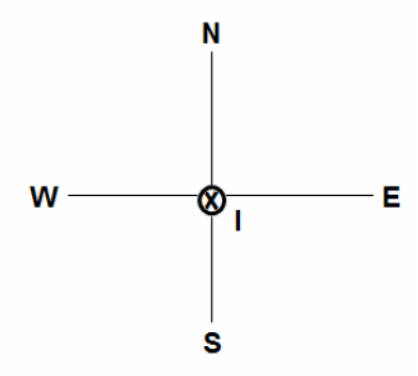
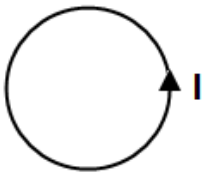
Magnetism
Practice Problems
PSI AP Physics B

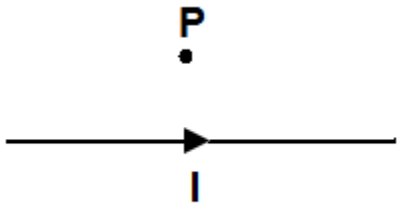
Name_____



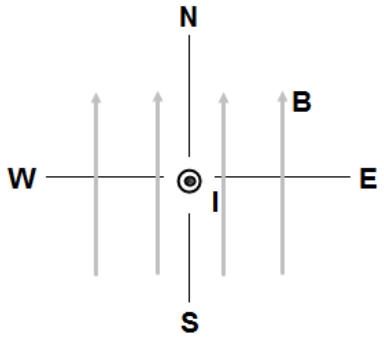
1. A straight wire carries a current down. What is the direction of the magnetic field at the point to the East from the wire?
   (A) West (B) East (C) North (D) South (E) Down



2. A loop of wire carries a current in counterclockwise direction. What is the direction of the magnetic field inside the loop?
   (A) Point to the left (B) Points to the right (C) Points out of the page
   (D) Points into the page (E) Curls in a clockwise direction



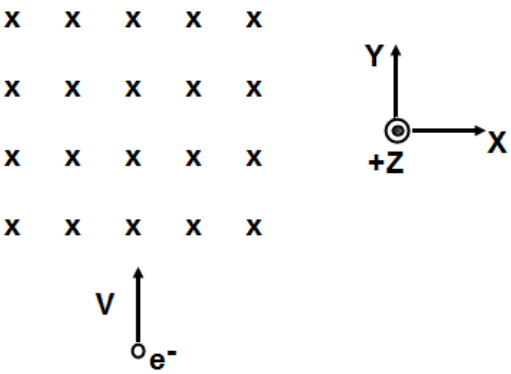
3. A current carrying wire is placed horizontally and has a current flow to the right. What is the direction of the magnetic field at point P?
   (A) Points to the right (B) Points to the left (C) Points to the top of the page
   (D) Points to the bottom of the page (E) Points out of the page



4. A vertical wire carries a current straight up in a region of the magnetic field directed north. What is the direction of the magnetic force on the current due to the magnetic field?
   (A) East (B) South (C) North (D) West (E) Applied force is zero

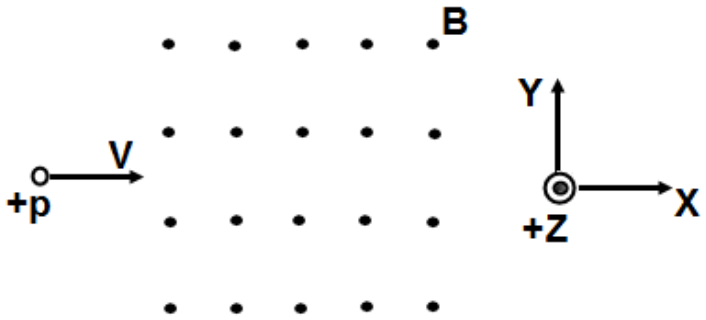
5. A horizontal thin wire has a mass m and length L. The wire carries a constant current I. What must be the direction of the magnetic field in order to cancel the gravitational force?
   (A) Left (B) Right (C) Down the page (D) Out of the page (E) Into the page

6. A horizontal thin wire has a mass m and length L. The wire carries a constant current I. What must be the magnitude of the magnetic field in order to cancel the gravitational force?
   (A) IL/mg (B) mg/IL (C) Ig/mL (D) Im/gL (E) Zero



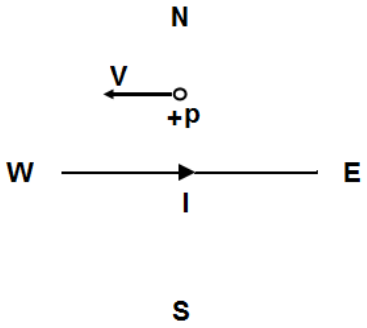
7. An electron enters a uniform magnetic field directed in –Z. What is the direction of the magnetic force on the electron due to the magnetic field?
   (A) +X direction (B) +Y direction (C) -X direction (D) –Y direction

   (E) Applied force is zero

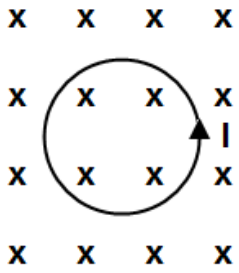


8. A proton enters a uniform magnetic field directed in +Z. What is the direction of the magnetic force on the proton due to the magnetic field?
   (B) +X direction (B) +Y direction (C) -X direction (D) –Y direction

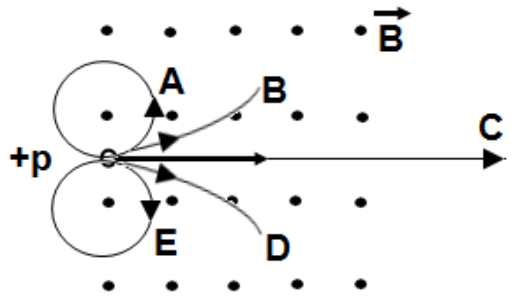
   (E) Applied force is zero



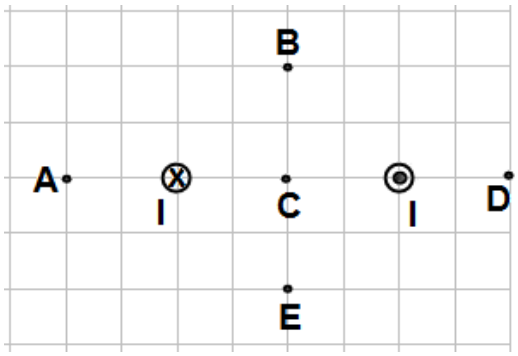
9. A horizontal wire carries a current to the east. A proton moves to the west in the region north from the current. What is the direction of the magnetic force on the proton?
   (A) West (B) North (C) East (D) South (E) Applied force is zero



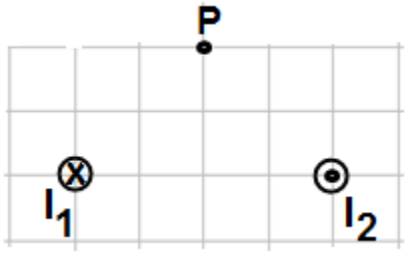
10. A circular loop of wire carries a constant current in counterclockwise direction. The loop is placed in a uniform magnetic field directed into the page. What is the effect of the magnetic force on the loop?
    (A) Rotates with respect to its axis (B) Rotates with respect to its diameter
    (B) Contracts its size (D) Expends its size (E) No effect on the loop



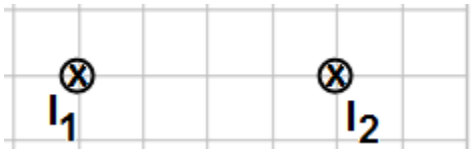
11. A proton enters a uniform magnetic field perpendicular to the field lines. What is the new path of the proton as it passes the field?
    (A) A (B) B (C) C (D) D (E) E



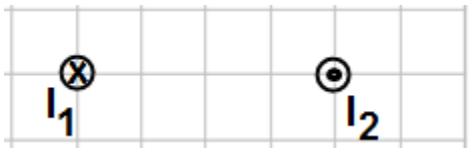
12. A magnetic field is created by two parallel currents flowing in opposite directions. At which location the magnetic field is greatest in magnitude?
    (A) A (B) B (C) C (D) D (E) E



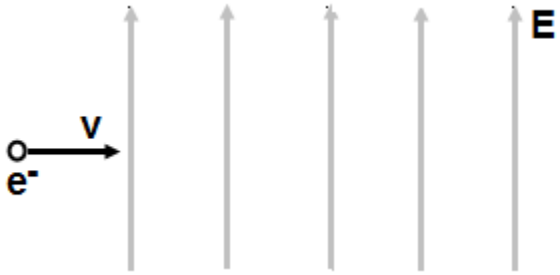
13. Two parallel wires carry currents in opposite directions. What is the direction on the net magnetic field at point P?
    (A) Left (B) Right (C) Top the page (D) Bottom the page (E) Into the page



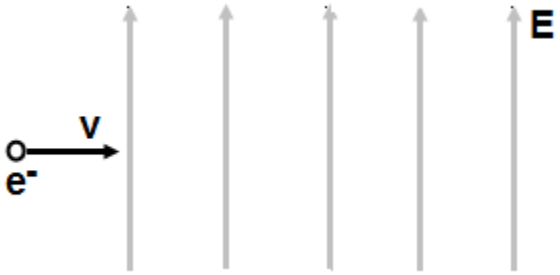
14. Two parallel wires carry currents in the same direction. What is the direction of the magnetic force on current I_2 due to current I_1?
    (A) Left (B) Right (C) Top the page (D) Bottom the page (E) Out of the page



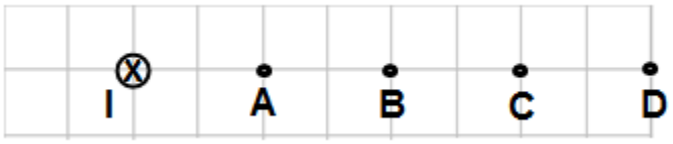
15. Two parallel wires carry currents in opposite directions. What is the direction of the magnetic force on current I_1 due to current I_2?
    (A) Left (B) Right (C) Top the page (D) Bottom the page (E) Out of the page



16. An electron enters a uniform electric field perpendicular to the field lines. What must be the direction of the magnetic field in order to cancel the electric force effect?
    (A) Left (B) Right (C) Top the page (D) Into the page (E) Out the page

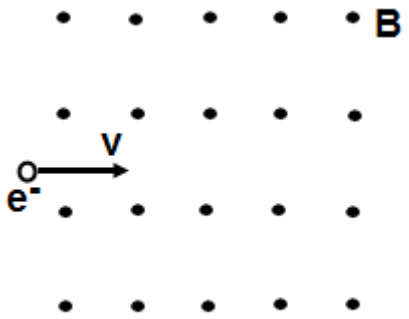


17. An electron enters a uniform electric field perpendicular to the field lines. What is the magnitude of the magnetic field if the electric effect completely canceled?
    (A) Ev (B) v/E (C) zero (D) E/v (E) eEv



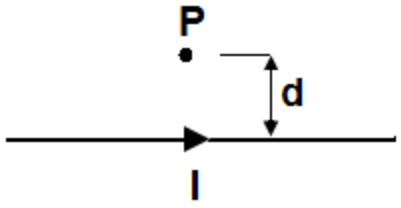
18. What is the magnitude of the magnetic field at point B produced by a current I if the magnitude of the field at point A is B_0?
    (A) B_0 (B) $2B_0$ (C) $4B_0$ (D) $B_0/2$ (E) $B_0/4$

19. Two parallel wires carry currents I_1 and I_2 in the same direction and separated by a distance d. The magnitude of the magnetic force between the wires is F_0. What is the force between the wires if each current is doubled and the separation is quadrupled?
    (A) $2F_0$ (B) $4F_0$ (C) F_0 (D) $F_0/2$ (E) $F_0/4$

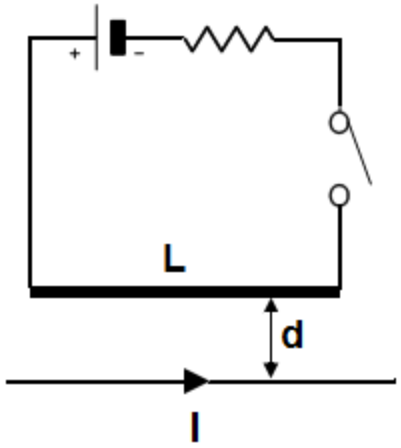


20. An electron with a mass m and charge e enters at a constant speed v a uniform magnetic field B. What is the radius of the curvature of the electron in the field?
    (A) mv/eB (B) eB/mv (C) me/vB (D) mB/ev (E) zero

Free-Response Problems



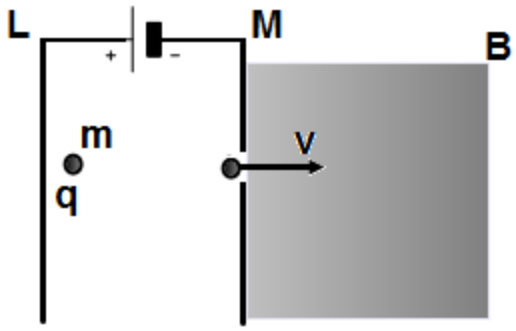
1. A long horizontal wire carries an electric current I = 50 A. Point P is located at a distance 2.5 mm above the current.
    a. What is the direction of the magnetic field at point P?
    b. What is the magnitude of the magnetic field at point P?



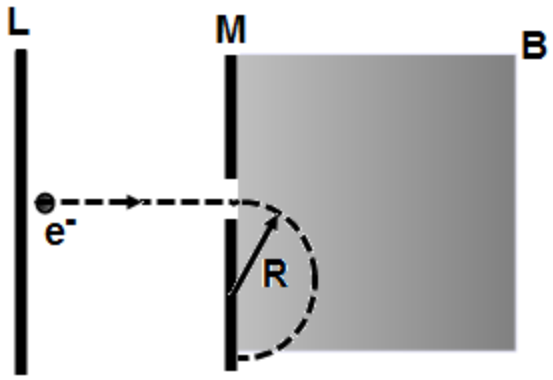
A thin horizontal rod has a length L = 1 m and mass m = 50 g is connected to a circuit. The circuit contains a battery V = 12 V, a resistor R = 0.06 Ω, a switch, and connecting wires. The rod is supported in horizontal position by two light connecting wires.

    c. What is the direction of the electric current in the rod?
    d. On the diagram below show all the applied forces on the rod.

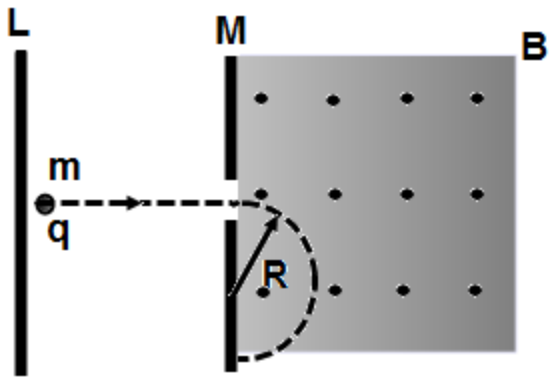
    e. What is the tension force in supporting wires?



2. Charged particle of mass m and charge q is released from rest in region between two charged plates M and L. After passing the region of the electric field with an accelerating voltage V_a the particle enters another region filled with a magnetic field of magnitude B and directed out of the page.
   a. What is the sign of the charge on the particle?
   b. What is the velocity of the particle as it enters the magnetic field?
   c. What is the direction of the magnetic force on the particle?
   d. Describe the path of the particle in the magnetic field.
   e. What is the radius of the curvature of the particle in the magnetic field?
   f. What is the direction and magnitude of the electric field that can be used to make the path of the particle straight?



3. An electron is accelerated by an electric field produced by two parallel plates M and L. When the electron enters a region filled with a magnetic field of magnitude B = 0.5 T its velocity v = $1.6 \cdot 10^7$ m/s.
   a. What is the direction of the accelerating electric field between the plates M and L?
   b. What is the accelerating voltage of the electric field?
   c. What is the direction of the magnetic field?
   d. What is the radius of the curvature of the electron in the magnetic field?
   e. What is the direction of the deflecting electric field required to make the electron's path straight?
   f. What is the magnitude of the deflecting electric field?

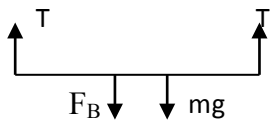


4. In a mass spectrometer a charged particle is accelerated to a velocity v = 5.9 ·10^7 m/s by an electric field and allowed to enter a magnetic field B, where it is deflected in a semi-circular path of radius R = 10 cm. The magnetic field is uniform of magnitude B = 16 T and oriented out of the page.
   a. What is the sign of the charge on the particle?
   b. What is the acceleration of the particle in the magnetic field?
   c. What is the ratio between the charge and mass of the particle q/m?
   d. What is the direction of the accelerating electric field?
   e. What is the accelerating voltage of the electric field?

Multiple Choice Answers

1. D
2. C
3. E
4. D
5. D
6. B
7. A
8. D
9. B
10. B
11. E
12. C
13. D
14. A
15. A
16. E
17. D
18. D
19. C
20. A

Free Response Answers

1. a. Out of the Page
   b. 4×10^{-3} T
   c. To the Right
   d. 

   e. 1.3 N or .65 N each

2. a. Positive
   b. $\sqrt{\frac{2gVa}{m}}$
   c. Down
   d. Circular
   e. $\frac{m}{gB}\sqrt{\frac{2gVa}{m}}$
   f. $\sqrt{\frac{2gVa}{m}}B$

3. a. Left
   b. 729 V
   c. Into the page
   d. 1.8×10^{-4} m
   e. Down
   f. 8×10^{6} N/C

4. a. Positive
   b. 3.5×10^{16} m/s^2
   c. 3.7×10^{7} C/kg
   d. Right
   e. 4.7×10^{7} V